

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Method and Apparatus for Laminating Plastic Materials to Substrates

We, THE DOW CHEMICAL COMPANY, a Corporation organised and existing under the Laws of the State of Delaware, United States of America, of Midland, County of Midland, State of Michigan, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates generally to a method and apparatus for laminating plastic materials with various substrates and, more particularly, relates to a method and apparatus for applying a plastic film or a foamed or foamable plastic composition to a substrate in a continuous manner.

It is well known that several problems exist in the manufacture of conventional extrusion laminations whereby a flat sheet of thermoplastic material is drawn through an extrusion orifice and subsequently applied to a substrate. These problems have also been experienced in attempts to similarly laminate foamable and foamed compositions to substrates. Part of the problem is caused by the irretrievable loss of heat from the time the plastic material leaves the extruder until it is engaged by the base material, and by the orientation of the plastic material, the latter being particularly a problem in the lamination of films to substrates. These problems have made certain applications impractical, such as the use of a plastic backing for tufted carpeting, particularly since a heated plastic film must be forced into the yarn because the film cannot be applied or heated to a low enough viscosity state to flow into the yarn. Similar problems appear in laminations of plastic materials to pervious materials such as fabric, and paper

stocks and to impervious substrates such as sheet metal.

In accordance with the present invention there is provided a process for the manufacture of laminate structures containing in intimate joined relationship at least one plastic layer and one substrate layer which comprises extruding a molten or liquid plastic composition through two or more substantially adjacent orifices onto a substrate held against the extruder orifice nearest thereto such that two or more plastic layers are deposited on the substrate as a composite coating layer. Furthermore it may be advantageous for the adjacent plastic layers to be interactive with each other.

The process of the invention is particularly useful in manufacturing laminate structures in which the plastic layer is a foamable plastic such as a thermoplastic composition containing a blowing or expanding agent or the two interactive components of a urethane polymer system. Desirably the foamable composition is foamed.

The invention also relates to the laminate structures obtained by the process and to the apparatus which has made the process of the invention operable.

As previously indicated the invention resides in the application of plastic compositions to a substrate wherein the substrate functions as one of the die lips of an extruder, with the substrate aiding the mechanical forwarding of the plastic composition whereby pressure uniformity is maintained and the residual heating of the plastic material is retained until an effective lamination occurs.

The primary difference between conventional extrusion lamination and the present invention is that in the latter the substrate effectively forms one of the die lips extending from the extruder while in the former

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the substrate passes some distance below an extruder die which is complete in itself, with the extrudate just being placed on the passing substrate. The arrangement of the apparatus of the present invention eliminates the cooling effect of surrounding air at the point of lamination, and eliminates the problem of distribution of plastic material along the width of a wide plate die. The pumping or mechanical moving characteristic of the substrate, which in effect provides for a continual replacement of a die lip, is the reason for lack of pressure distribution problems with the present invention.

One application of the present invention which has proved practical is the lamination of a polyurethane type foam with cloth and fabric substrates. Apparatus 26 for accomplishing this is schematically illustrated in the accompanying drawing wherein a first component e.g. the cross-linker, is provided through a channel 27 formed between a first die lip 28 and a second die lip 29 and a second component e.g. the prepolymer is provided through channel 31 formed between the second die lip 29 and a third die lip 30, are applied to a cloth substrate 32. A back-up roller 18 for forwarding the substrate is located closely adjacent to die lip 26 such that the substrate 32 when passing around the roller in a clock-wise manner, is held against and provides an extension of die lip 28 opposing die lips 29 and 30, respectively.

Press rollers 23 can be located closely adjacent extruder 16 (only partially shown) for further effecting the lamination and the rollers 23 can permit foaming as the lamination is cooled. If cooled sufficiently there can be provided a foamable polymeric composition laminated to the substrate. It is to be understood that surfaces other than the roller 18 can be employed to press substrate 32 against die lip 28 e.g., a straight surface or air pressure. It is to be understood also that ways other than rollers 23 can be provided to chill the laminate e.g. a cool air blower. A chemical reaction between the cross-linking composition and the prepolymer takes place on the substrate as the latter passes past die lip 29 where the cross-linking composition and prepolymer mix. Die lip 28 is closely spaced to the substrate 32. Die lips 29 and 30 are each preferably stepped from the substrate a distance greater than that of the former so that a thin layer of the first component is laid on the substrate, and a thin layer of the second component is laid on the first component respectively. The interfacial shearing at the juncture of the two components gives rise to adequate mixing.

Polymers which can be effectively applied by the aforementioned exemplary method are low density polyethylene and copolymers of ethylene with ethyl acrylate. Copolymers con-

taining approximately thirty-eight percent inert fillers such as CaCO_3 also have been effectively used. However, it is to be understood that any plastic material which can preferably be extruded at temperatures up to approximately 800°F. (427°C.) may be employed, such as the polyolefins, polystyrene, polyvinyl chloride, polyacrylate, polyvinylidene chloride, cellulose, polyamides and two or multi component urethane polymer-forming reactants and combinations of two or more of the aforementioned thermoplastic materials. The temperature of operation will necessarily depend on the material being extruded, the optimum extrusion conditions for each of the classes of polymers being well known to those versed in the art of plastics extrusion.

It may be desirable to deposit as one of the plastic layers on the substrate a thermoplastic foam layer. Alternatively one or more of the plastic layers may contain an expanding agent to provide, upon sufficient cooling of the substrate at or near the point of extrusion a foamable plastic layer which can be subsequently expanded or foamed by the application of heat.

Coating speeds will generally depend on the substrate to be coated and the weight of the coating to be applied. Speeds of less than one foot (30.5 cm.) per minute can be used in some cases while the other substrates may allow speeds as high as one thousand feet (305 m.) per minute. Generally however, when coating carpet, coating weights of from six to twenty ounces per square yard (0.02 to 0.07 gms/cm²) are generally preferred with a coating rate between five and fifty feet (1.52 to 152 m.) per minute being advisable. This is because slower speeds are undesirable as far as production output is concerned and higher speeds are not practical because carpeting cannot generally be handled efficiently above this rate.

Other experiments have proved that the method and apparatus of the present invention can be employed in coating non-porous materials such as sheet metal. Other applications can be in coating rainware, carpet seaming tape and paper stocks, it being understood that the present method and apparatus can have a wide range of applications.

WHAT WE CLAIM IS:—

1. A process for the manufacture of laminate structures containing in intimate joined relationship at least one plastic layer and one substrate layer which comprises extruding molten or liquid plastic composition through two or more substantially adjacent orifices onto a substrate held against the extruder orifice nearest thereto such that two or more layers of plastic are deposited on the substrate as a composite coating layer.

2. A process as claimed in claim 1 charac-

- terized in that adjacent plastic layers are interreactive with each other.
3. A process as claimed in claim 1 or 2 characterized in that at least one of the plastic layers is a foamable plastic composition.
- 5 4. A process as claimed in claim 3 characterized in that the foamable plastic composition is foamed.
- 10 5. A process as claimed in any one of claims 1 to 4 characterized in that the composite coating layer consists of or contains a thermoplastic polymer.
- 15 6. A process as claimed in any one of claims 1 to 4 characterized in that the composite coating layer consists of or contains a urethane polymer.
- 20 7. Apparatus when used for carrying out the process claimed in any one of claims 1 to 6 comprising means for extruding a plastic composition through two or more substantially adjacent orifices onto a substrate, means for forwarding the substrate and means for holding the substrate against the lip of the extrusion orifice nearest the substrate.
- 25 8. Apparatus as claimed in claim 7 characterized in that two or more plastic compositions are extruded through the orifice nearest the substrate and one or more adjacent orifices.
- 30 9. A process for the manufacture of laminate structures substantially as hereinbefore described.
10. Apparatus for the manufacture of laminate structures substantially as hereinbefore described with reference to the accompanying drawing.
- 35 11. Laminate structures whenever obtained by the process claimed in any one of claims 1 to 6 or by means of the apparatus claimed in any one of claims 7, 8 or 10.
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COMPLETE SPECIFICATION

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*This drawing is a reproduction of
the Original on a reduced scale*

